CLAIMS

What is claimed is:

1. An optical spectrum analyzer comprising:

a receiver, for generating three or more phase-diverse mixed signals as a function of an optical local oscillator signal and an unknown optical signal;

a phase quadrature generator coupled to said receiver, for generating a first and a second phase quadrature signals as a function of said three or more phase-diverse mixed signals; and

a complex signal generator coupled to said phase quadrature generator, for generating a complex signal as a function of said first and said second phase quadrature signals.

2. The optical spectrum analyzer according to Claim 1, further comprising:

a measurement processing unit coupled to said complex signal generator, for determining a phase of said unknown optical signal as a function of said complex signal; and

a display unit coupled to said measurement processing unit for presenting said phase.

3. The optical spectrum analyzer according to Claim 2, wherein determining said phase of said unknown optical signal comprises determining a phase difference between a negative image component and a positive image component of said complex signal.

4. The optical spectrum analyzer according to Claim 2, wherein said measurement processing unit further determines an amplitude of said unknown optical signal as a function of said complex signal.

5. The optical spectrum analyzer according to Claim 2, wherein said measurement processing unit further determines a spectral characteristic, selected from the group consisting of chirp, chromatic dispersion and polarization mode dispersion, as a function of said complex signal.

6. The optical spectrum analyzer according to Claim 1, wherein said receiver comprises:

a coupler for combining and splitting said optical local oscillator signal and said unknown optical signal; and

an optical detector coupled to said coupler, for generating said three or more phase-diverse mixed signals as function of said combined and split said optical local oscillator signal and said unknown optical signal.

7. The optical spectrum analyzer according to Claim 2, further comprising a complex filter coupled between said complex signal generator and said measurement processing unit, wherein a positive and a negative image of said complex signal are isolated from said complex signal.

8. The optical spectrum analyzer according to Claim 7, wherein an isolation frequency of said complex filter is chosen to allow for simultaneous measurement of two sidebands within said unknown optical signal.

9. The optical spectrum analyzer according to Claim 8, wherein determining said phase of said unknown optical signal comprises determining a phase difference between said negative image component and said positive image component of said complex signal.

10. The optical spectrum analyzer according to Claim 1, wherein said receiver comprises:

a modulator, for receiving said optical local oscillator signal and generating a modulated optical local oscillator signal;

a coupler coupled to said modulator, for combining and splitting said modulated optical local oscillator signal and said unknown optical signal; and

an optical detector coupled to said coupler, for generating said three or more phase-diverse mixed signals as a function of said combined and split said modulated optical local oscillator signal and said unknown optical signal.

11. The optical spectrum analyzer according to Claim 1, wherein said receiver comprises:

a polarization splitter for receiving said unknown optical signal, wherein a first polarized unknown optical signal and a second polarized unknown optical signal are generated as a function of said unknown optical signal;

a first optical coupler coupled to said polarization splitter, for receiving said first polarized unknown optical signal and said optical local oscillator signal;

a first optical detector coupled to said first optical coupler, for outputting a first set of three or more phase-diverse mixed signals;

a second optical coupler coupled to said polarization splitter, for receiving said second polarized unknown optical signal and said optical local oscillator signal; and

a second optical detector coupled to said second optical coupler, for outputting a second set of three or more phase-diverse mixed signals that are polarization-diverse with respect to said first set of three or more phase-diverse mixed signals.

12. An optical spectrum analyzer comprising:

a first optical coupler comprising;

a first coupler input for receiving an optical local oscillator signal;

a second coupler input for receiving an unknown optical signal; and

a first plurality of coupler outputs;

a first optical detector comprising a first plurality of photo detectors, wherein each photo detector is coupled to a corresponding one of said first plurality of coupler outputs of said first optical coupler;

a first subtraction unit coupled to said first optical detector;

a first transformation unit coupled to said first subtraction unit; and

a first complex signal generation unit coupled to said first transformation unit.

13. The optical spectrum analyzer according to Claim 12, further comprising:

a first complex filter coupled to said first complex signal generation unit; and

a measurement processing unit coupled to said first complex filter.

14. The optical spectrum analyzer according to claim 13, further comprising an optical modulator coupled between said local oscillator signal and said first input of said first optical coupler.

15. The optical spectrum analyzer according to claim 14, wherein an isolation frequency of said complex filter corresponds to a function of the frequency spacing of the sidebands of said unknown optical signal.

16. A spectral phase measurement method comprising:

generating three or more phase-diverse mixed signals as a function of an optical local oscillator signal and an unknown optical signal;

generating a first and a second phase quadrature signals as a function of said three or more phase-diverse mixed signals; and

generating a complex signal having a negative image component and a positive image component, as a function of said first and second phase quadrature signals.

17. The method according to Claim 16, further comprising determining a relative phase difference between said negative image component and said positive image component.

18. The method according to Claim 17, further comprising determining an amplitude of said unknown optical signal from a component of said complex signal consisting of the group comprising an amplitude of said negative image component, an amplitude of said positive image component, and an average amplitude of said negative image component and said positive image component.

19. The method according to Claim 18, further comprising sweeping said local oscillator signal across a frequency spectrum of said unknown optical signal.

20. The method according to Claim 19, further comprising determining a spectral characteristic of said unknown optical signal as a function of said determined relative phase difference and said determined amplitude for each of said frequency of said optical local oscillator signal.

21. The method according to Claim 20, wherein said spectral characteristic is selected from a group consisting of phase, amplitude, frequency, polarization, chirp and dispersion.

22. The method according to Claim 16, wherein said generating said three or more phase-diverse mixed signals comprises:

combining said optical local oscillator signal and said unknown optical signal;

splitting said combined said optical local oscillator signal and said unknown optical signal into three or more phase-diverse combined signals; and

converting each of said three or more phase-diverse combined signals into a corresponding one of said three or more phase-diverse mixed signals.

23. The method according to Claim 16, wherein said generating said first and said second phase quadrature signals comprises:

generating a first and a second difference signals as a function of said three or more phase-diverse mixed signals; and

generating said first and said second phase quadrature signals as a function of said first and said second difference signals.

24. The spectral phase measurement method according to Claim 23, further comprising:

sweeping a frequency of said optical local oscillator signal through a frequency spectrum of said unknown optical signal; and

determining a spectral phase characteristic of said unknown optical signal as a function of a relative phase difference between said negative image component and said positive image component, for each of said frequency of said optical local oscillator signal.

25. The spectral phase measurement method according to Claim 24, further comprising determining a spectral amplitude characteristic of said unknown optical signal as a function of a component of said complex signal for each of said frequency of said optical local oscillator signal, wherein said component of said complex signal is selected from the group consisting of an amplitude of said negative image component, an amplitude

of said positive image component, and an average amplitude of said negative image component and said positive image component.

26. The spectral phase measurement method according to Claim 25, further comprising determining a complex domain representation of said unknown optical signal as a function of said spectral phase characteristic and said spectral amplitude characteristic.

27. The spectral phase measurement method according to Claim 26, further comprising determining a time domain representation of said unknown optical signal as a function of said complex domain representation.